

2 April 2007

CRUISE RESULTS

NOAA Fisheries Research Vessel DELAWARE II
Cruise DE 07-10 (Parts I - II)

Atlantic Herring Acoustic Survey

CRUISE PERIOD AND AREA

This years Atlantic Herring Acoustic Survey consisted of only two parts (Part I and Part II) instead of the usual three part survey. The NOAA ship Delaware II developed problems with a reduction gear and could only maintain a steady 8 knots cruise speed. The ship did not have enough power to tow the High Speed Midwater Trawl until the reduction gear problem was repaired. Cruise operations were conducted on the continental shelf (depths to 350 m) in the Gulf of Maine and northern Georges Bank regions, including the Canadian Exclusive Economic Zone on eastern Georges Bank. Part I of the survey (4-11 September) was dedicated to calibrating the scientific echo sounders on the FRV Delaware II and testing the Advanced Fisheries Tow Vehicle (AFTV) launch and recovery operations. The annual systematic acoustic and biological survey of Atlantic herring was conducted in the Georges Bank region during Part II (24 September-17 October).

OBJECTIVES

The Northeast Fisheries Science Center (NEFSC) conducts annual Atlantic Herring acoustic surveys each autumn on the historical spawning grounds of Atlantic herring (*Clupea harengus*) in the Georges Bank and Gulf of Maine regions. The main goal of this cruise was to provide timely and accurate fisheries-independent estimates of herring spawning stock biomass using state-of-the-art technologies. Operational objectives were to (1) calibrate the EK500 Scientific Sounder, (2) conduct deployment tests and evaluate the new Advanced Fisheries Tow Vehicle, (3) conduct systematic acoustic surveys of selected Atlantic herring spawning stocks, (4) collect *in situ* target strength data with the EK500 and EK60, and (5) collect biological data to verify species-specific acoustic measurements using midwater trawls and underwater video.

METHODS

Calibrations and Ambient Noise Tests of the EK500: Calibrations are required during each survey to ensure data quality and verify echo sounder performance. The EK500 was calibrated by suspending standard calibration spheres of known target strength under each transducer from three monofilament lines. The calibration sphere was centered in the far field of each transducer and moved throughout the acoustic beam beneath the

vessel using remotely controlled downriggers. The 38- and 120-kHz split-beam transducers were calibrated in Cape Cod Bay during Part I of the survey, and the 18-kHz split-beam transducer was calibrated in Cape Cod Bay during Part II. Noise tests of the EK500 were conducted dockside and while the vessel was underway at 10 knots (survey speed).

Simrad EK500 Scientific Sounder: The Simrad EK500 Scientific Sounder was the primary sampling gear used during the acoustic surveys for providing species-specific abundance estimates. The EK500 operated three hull-mounted transducers (18-, 38-, and 120-kHz split-beam transducers). The EK500 was interfaced via TCP/IP Ethernet to the FRV DELAWARE'S SCS server for data logging using SonarData EchoLog software. RS232 connections were used for navigational (Differential GPS) input. The SCS Event Log was used to record all operational events (e.g., begin and end points of transects, stations, gear deployments, and other events that affect the track cruise and vessel speed) during the cruise.

Advanced Fisheries Towed Vehicle (AFTV): The AFTV is a recently constructed platform designed to deploy integrated acoustical, optical, and environmental sensors for verifying acoustic backscatter from the water column and seafloor. The AFTV was deployed using a portable fiber optic winch system equipped with 2000 m of 0.322 inch cable, and has an overall weight of about 5,000 lb. The cable has three single mode fiber optic and three copper conductors, and has an 11,000 lb/ft breaking strength rating. The AFTV towbody weighs about 900 lb and is approximately 7 ft in length. The AFTV also has a 100 lb counter weight arranged about 20 m in front of the towbody to dampen the vessel motion for maintaining the horizontal stability of the towbody. This requires a two point deployment approach using the vessel's aft A-frame and articulating crane on the aft deck. The AFTV was configured with an EK60 38 kHz, CTD, motion sensor, and various underwater cameras and lighting. The AFTV was towed intermittently at relatively slow speeds (1-3 knots) above the seafloor and throughout the water column to collect *in situ* target strength data and verify acoustic backscatter.

Acoustic Survey Operations: EK500 data were collected continuously throughout the cruise. During the surveys, a constant ship speed of 10 ± 1 knots was maintained. Vessel speed was reduced to no less than 8 knots during rough seas. EK500 operations were generally suspended when seas exceeded 2 m. Each transect was assigned a sequential number throughout the cruise. A transect was defined as a portion of the cruise track with a constant heading and ship speed. All scientific gear deployments were also assigned a unique, sequential deployment number.

EK500 and EK60 Target Strength Measurements: Target strength measurements with the hull-mounted EK500 split-beam transducers and with the AFTV-mounted 38-kHz EK60 split-beam transducer (ES38-DD) were collected on selected fish aggregations. The vessel was positioned over aggregations, and the towbody was deployed from the vessel's aft A-frame while drifting for 30-60 minutes.

SonarData Echoview Post-processor: SonarData software (v. 4.2) was used for data acquisition and post-processing of EK500 data during the cruise. Echoview was used to conduct preliminary post-processing of EK500 data at sea, which involved removing extraneous bottom echoes and/or water column noise. Echoview was also used to partition acoustic backscatter to Atlantic herring. EK500 data and Echoview files were logged and archived directly to the SCS system via a TCP/IP Ethernet connection. Three computers were set up for the acoustic data. One computer was used for EK500 data acquisition using EchoLog. This computer was located in the SCS room and was part of the SCS system. The other two computers were set up in the dry lab, with one computer used for post-processing and the other used for viewing data in real time.

Irish Midwater Herring Trawl (IMHT): The IMHT midwater trawl was used to collect biological samples and verify species composition of acoustic backscatter. The IMHT was designed to be fished at speeds of about 4 knots. The IMHT was deployed during survey operations, and targeted on acoustic backscatter. The IMHT was towed at about 4 knots, depending on trawl performance and water currents. The duration and depth of the trawls were not standardized, and the Chief Scientist or Watch Chief communicated with the bridge officers as to the haul duration and depths. The Simrad FS903 was deployed with every haul. Officers recorded the time, date, navigational, and station data in FSCS, while the scientists recorded the catch and ITI data for each station deployment. Catch data was recorded using the FSCS on-board entry system.

Simrad FS903 Trawl Monitoring and Third-wire Winch System: The trawl was monitored during fishing operations using the FS903. The Simrad FS903 Trawl Monitoring System was a third-wire device that provided real-time trawl performance information through its sonar images of the trawl opening. The scientific party recorded measurements on hardcopy forms at specified intervals during each deployment.

Scientific Computer System (SCS) and Fisheries Scientific Computer System (FSCS): The SCS system is a PC-based server, which continuously collects and distributes scientific data from various navigational, oceanographic, meteorological, and sampling sensors throughout the cruise. The SCS Event Log program was configured for NEFSC Fisheries Acoustic Survey operations, and was used by the scientists to document all operational events (*e.g.*, begin and end of transects and deployments). Dates and times were synchronized using the vessel's GPS master clock and Dimension IV software. The FSCS system was used for on-board data logging of the biological and catch data.

Conductivity-Temperature-Depth (CTD) Profiler: A Seabird CTD profiler was deployed at the beginning and ending of each transect, and at the beginning of each scientific gear deployment to define the hydrographic conditions in the study area. Water bottle casts were also deployed twice per day to collect salinity samples.

Vemco Minilog Probes: Temperature-depth probes (set at a 1 or 2 sec sampling rate) were attached to the midwater trawl headrope and footrope during trawl hauls.

Biological Sampling: Trawl catches were sorted by species, weighed and measured (to the nearest cm FL) according to standard NEFSC procedures. For Atlantic herring, subsamples were taken for each trawl haul for detailed lengths (FL in mm), individual weights (to nearest 0.1 g), sex/maturity staging, and otolith samples (freeze herring whole). Subsampling protocol was 1 fish per centimeter length class for herring less than 25 cm and 3 fish per centimeter length class for herring 25 cm and longer. The FSCS system was used for on-board entry and auditing of trawl station and biological data. Biological data were transferred to the NEFSC for auditing.

RESULTS

Part I

Part I of the Atlantic Herring Acoustic Survey was dedicated to testing the deployment and operation of the Advanced Fisheries Tow Vehicle (AFTV). Dockside testing of the AFTV hardware and software was conducted on Sept. 4th. The Delaware II departed Woods Hole on Sep 5th and headed to Vineyard Sound for AFTV deployment testing. Three deployments were performed, with one deployment conducted during dusk to see what affects limited lighting would have on retrieving the vehicle. Different deployment methods were evaluated to determine the best procedure for launching the AFTV from the stern A-Frame. The Delaware II remained in Vineyard Sound until the following day to await favorable tides for the transit to Cape Cod Bay.

The Delaware II departed Vineyard Sound and arrived in Cape Cod Bay on 6 September. Additional deployments of the AFTV were conducted in the Bay to determine the vehicles stability in deeper water. With the 90 pound counterweight attached to the cable at approximately 20 feet from the vehicle, the AFTV was lowered to a depth of about 30 meters. With the vessel moving at about 2 knots through the water, the AFTV platform was not as stable as it should be. There was about a 2 to 4 degree variation in pitch, with both roll and yaw variation negligible. The vehicle was towed for approximately 1 ½ hours to see if the AFTV would stabilize. The pitch remained unstable. The AFTV was pulled to the surface, and an additional 100 pound counter weight was added to the cable. Now, with the total counterweight at approximately 190 pounds, the AFTV was lowered again to a depth of 30 meters. The AFTV platform was much more stable. The pitch variation was less than 0.5 degrees, with both roll and yaw variation still negligible. The rest of the day was spent in testing the AFTV electronics, and varying the depth of the AFTV to see how quickly the platform would stabilize.

Calibrations of the EK500 transducers were conducted on 7 and 8 September. Problems in steering the calibration spheres underneath the EK500 transducers were encountered on Sep. 7th. The portside downrigger monofilament would continually get hung up on the hull of the ship, making it nearly impossible to steer the calibration sphere underneath the 38- and 120-kHz transducers. Both the 38- and 120-kHz transducers were finally calibrated on 8 September. The 18-kHz transducer calibration was delayed until Part II of the survey. This transducer is very difficult to calibrate due to its location on the hull of the boat. More experienced personnel are required to perform this calibration. Once

the calibrations were completed, the AFTV was deployed one more time to give the Delaware II deck crew additional practice in deployment techniques prior to moving on to Georges Bank. Once the AFTV deployment was completed, the vessel began steaming to Georges Bank.

The Delaware II arrived at Georges Bank on 9 September. A series of parallel transects were set up to simulate a typical Hydro-acoustic survey. These transects were located along Franklin Basin. Halfway through transect # 1, a large school of herring was spotted on the EK500 echo sounders. The AFTV was deployed in order to capture video of this school. The vehicle was lowered to a depth of approximately 130 meters. At this depth, the AFTV had a stability problem. The pitch variation was about 20 degrees, with roll and yaw variation still negligible. Although the 190 pound counterweight at 20 feet from the vehicle absorbed the vessel heave at the shallower depths in Vineyard Sound and Cape Cod Bay, this setup would not work for the deeper waters in Georges Bank. The counterweight location on the cable needed to be much further than 20 feet away from the AFTV in order to absorb the vessel heave. The AFTV was safely recovered and the counterweight was relocated to 50 feet from the towbody. However, at this distance, the point where the counterweight attaches to the cable (through Chinese Fingers) does not pass through the cable block. This results in the towbody reaching the surface further behind the boat. The crew would not be able to reach the towbody in this position. This hypothesis was tested by securing a safety line to the towbody to use as an extra point at which the crew could haul in the towbody to get it closer to the boat if needed. The towbody was launched a second time, and the vehicle trailed behind the boat simulating the beginnings of the retrieval process. The AFTV was hauled back using the main armored tow cable until the Chinese fingers reached the block. At this point, the towbody was too far back from the boat, irregardless of which position the stern A-Frame was located. The crew could not reach the attachment points for the tag lines. At this point, the safety line was used to bring the towbody closer to the boat so that the crew could safely retrieve the vehicle. Additional modifications to the towbody and counter weight attachments will need to be made prior to Part II of the survey. No further AFTV deployments were conducted. The rest of the survey was dedicated to collecting EK500 echo sounder data in Georges Bank. At the conclusion of the survey, the Delaware II steamed back to Woods Hole and arrived in the afternoon of Sept. 11.

During this portion of the cruise 11 deployments (9 AFTV, and 2 CTD deployments) and 23 transects were completed.

Part II

The primary goal of Part II was to conduct the annual systematic acoustic survey of Atlantic herring along the northern edge of Georges Bank and southern Gulf of Maine. Due to vessel-related issues, the survey did not begin until Oct. 12. Survey operations included EK500 acoustic data acquisition, midwater trawl hauls, and CTD profiles. The vessel departed Woods Hole on Oct. 12 and steamed to Cape Cod Bay to calibrate. We completed the first calibration of the 18-kHz system and did a second calibration of the 38- and 120-kHz systems. All calibrations were successful with gain modifications within standard tolerances. A test tow of the AFTV was conducted in Cape Cod Bay.

We also retensioned the new Irish Midwater Herring Trawl (IMHT) in Cape Cod Bay. During the tow we ran into an issue of the engines overheating. This may be to the finer meshes creating more drag with the new net. The current resolution is to tow the net at slower speeds (3+ knots vs. 4+ knots for the high-speed midwater rope trawl). This appears to be beneficial for the vessel as well as the net seems to perform better at the lower speed. The mouth opening is about 40 m horizontal by 15 m vertical when set and fishing. Upon completion of these activities we steamed to the northeast peak of Georges Bank.

The vessel arrived on station on Oct. 14 and we commenced the survey. The survey consisted of parallel transects oriented north-south with 10 nmi spacing. Survey speed was consistently 10 ± 1 knots. CTD profiles were completed at the beginning and end of each transect and immediately prior to each trawl haul. Trawl locations were selected on an *ad hoc* basis to sample the acoustic backscatter.

Due to heavy seas, we steamed to Jeffreys Ledge on Friday afternoon (19 Oct.) to do a quick survey of this area for herring. We arrived late Friday night and commenced the survey. We observed small aggregations of herring on the west side of the ledge, but little to no herring on the eastern side of the ledge. We completed the survey on Sunday (21 Oct.) morning and are steaming back to Georges Bank to resume the main survey.

We resumed the herring survey on Oct. 21 near the western end of Georges Bank. The survey was completed on Oct. 26 with a total of 33 trawls, 3 AFTV deployments, 77 CTD profiles, 4 neuston tows, and 55 transects completed.

DISPOSITION OF DATA

Data and results were archived at the Northeast Fisheries Science Center (NEFSC). Data and results are available on CD-ROM or other media. Contact Michael Jech (Michael.Jech@noaa.gov). Cruise reports and results are also available at the NEFSC website: <http://www.nefsc.noaa.gov/femad/ecosurvey/acoustics/>

SCIENTIFIC PERSONNEL

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Michael Jech	Research Fishery Biologist	Part II
(Chief Scientist – Parts II)		
Joseph Godlewski	Electronics Engineer	Parts I, II
(Chief Scientist – Part I)		
Sarah Pike	Cooperative Prog. Spec.	Part I
TK Arbusto	Gear Specialist	Part II
David Chevrier	GIS Specialist	Part II

National Marine Fisheries Service, NEFSC, Milford, CT

David Vielleux	Biological Lab Tech.	Part I
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Contractors, NEFSC, Woods Hole, MA

Robert Gamble	Acoustic Scientist	Part II
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Tim Bertrand	Biologist	Part II

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Volunteers

Matthew Accardi	Staten Island, NY	Part II
Chris Cutler	Santa Cruz, CA	Part II

Part I: 4 – 11 September 2007

Part II: 12 – 26 October 2007

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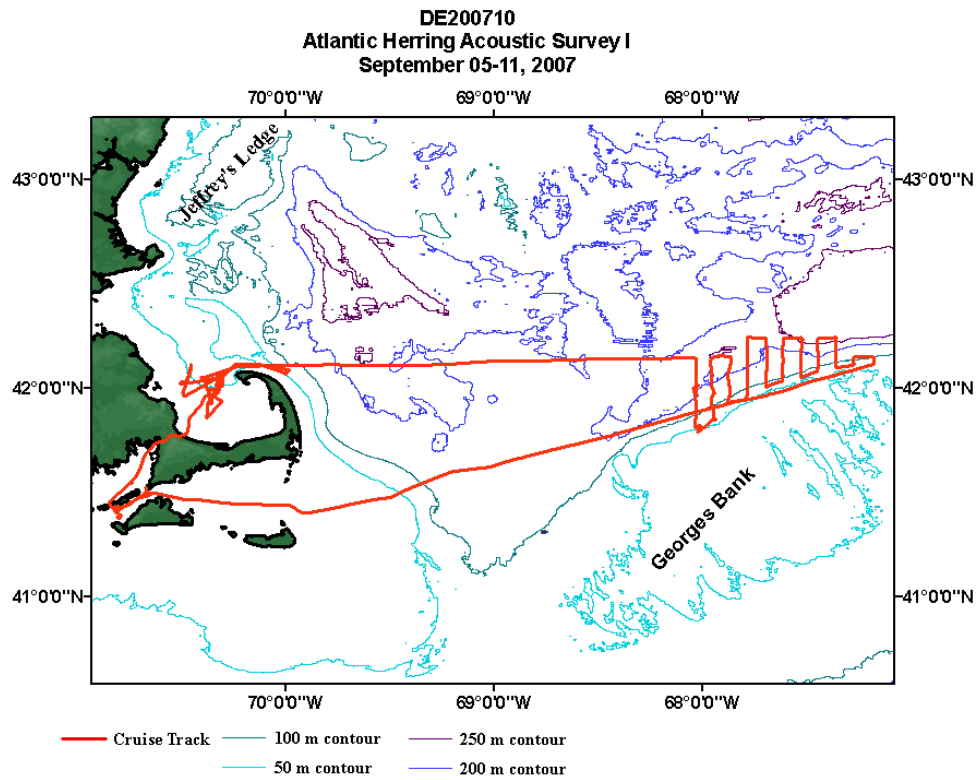


Figure 1. Part I (September 5-15, 2006) area of operations and cruise track for DE200615, Atlantic herring acoustic survey.

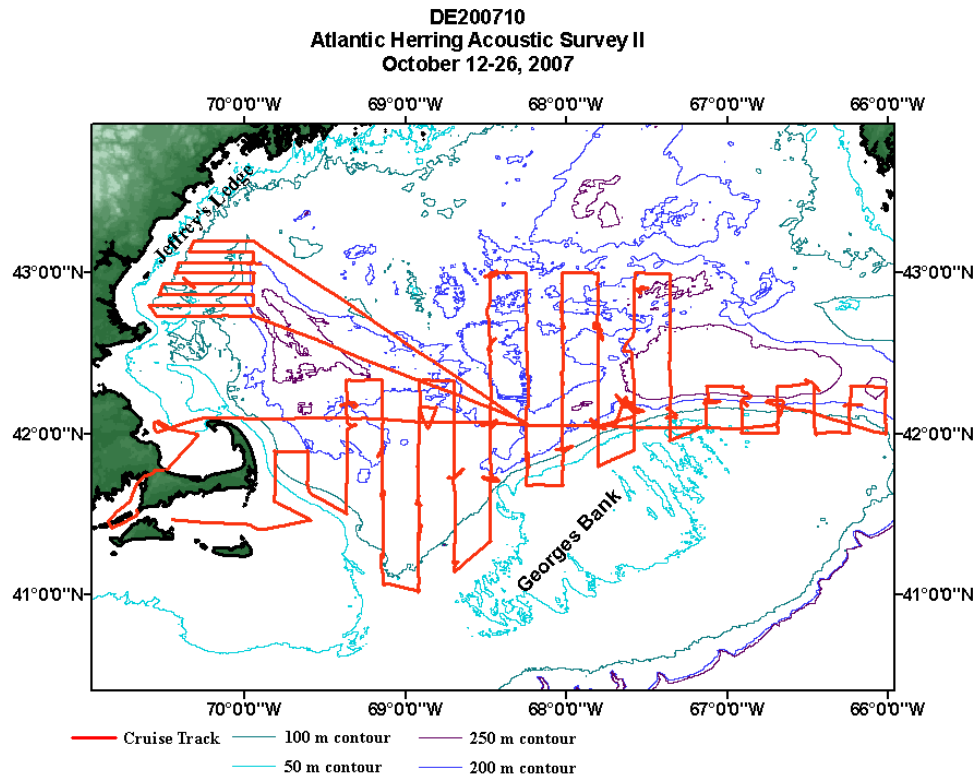


Figure 2. Part II (September 18-29, 2006) area of operations and cruise track for DE200615, Atlantic herring acoustic survey.